GAI CONSULTANTS

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GAI Consultants – NC, Inc.

3812-H Tarheel Drive
Raleigh, NC 27609
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June 13, 1996

Mr. Jim Bateson
Hydrogeologist
North Carolina Department of Environment,
Health, and Natural Resources
Division of Solid Waste Management
Post Office Box 27687
Raleigh, North Carolina 27611-7687

Re: Responses to Requested Amendments
Surface Water Sampling and Analysis Plan
Closed Avery County Landfill, Permit #06-01
Ingalls, North Carolina
Project No. 95144.02

Dear Mr. Bateson:

INTRODUCTION

Responses are made herein to the requested amendments in your letter of May 1, 1996 for the Surface Water Sampling and Analysis Plan for the Closed Avery County Sanitary Landfill, Permit #06-01.

RESPONSES TO SUGGESTED AMENDMENTS

Amendment: The monitoring plan need not include reference to total organic halogens (TOX) analyses.

Response: References to TOX analyses have been deleted from the enclosed Water Quality Monitoring Plan.

Amendment: Samples will need to be analyzed for the following field parameters: pH, temperature, and specific conductivity. Procedures for measuring these parameters need to be described in the monitoring plan. A copy of *Sampling and Analysis Requirements for Construction and Demolition Landfills* is attached for reference.

Response: As discussed during our phone conversation of June 7, 1996, you agreed that the requirements for measuring pH, temperature, and specific conductivity and the measuring procedures in the enclosed Water Quality Monitoring Plan are adequate.

Amendment: In order that the document can serve as a comprehensive monitoring plan, it would be better if well construction records for the three monitoring wells were included in the document, and the title of the document changed to "Water Quality Monitoring Plan."

Response: GAI was involved in the abandonment of Monitoring Well 1 and the installation of Monitoring Well 1R. The well construction record for Monitoring Well 1R along with a well construction

sheet for Groundwater Monitoring Wells 2 and 3 is attached to the letter of transmittal for the Water Quality Monitoring Plan.

CLOSURE

This letter responds to requested amendments of Mr. Jim Bateson on the Closed Avery County Landfill.

Respectfully submitted,
GAI Consultants - NC, Inc.

Kathleen Armstrong for

Thomas J. Rossbach, Ph.D., L.G.
Staff Geologist

Wendell W. Parker

Wendell W. Parker, Ph.D., P.E.
Vice President

Copy to: Wayne Sullivan, Municipal Engineering Services Company

GAI CONSULTANTS

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June 13, 1996

Mr. Jim Bateson
Hydrogeologist
North Carolina Department of Environment,
Health, and Natural Resources
Division of Solid Waste Management
Post Office Box 27687
Raleigh, North Carolina 27611-7687

Re: Water Quality Monitoring Plan
Closed Avery County Landfill, Permit #06-01
Ingalls, North Carolina
Project No. 95144.02

Dear Mr. Bateson:

The Solid Waste Section of the Division of Solid Waste Management of the North Carolina Department of Environment, Health, and Natural Resources instructed Avery County to include sampling and testing of upgradient and down gradient surface waters as a part of the groundwater quality monitoring system at the closed Avery County Landfill, Ingalls, North Carolina. Surface water locations were mutually established in a meeting on site between Jim Bateson, Solid Waste Section; Wayne Sullivan, Municipal Engineering Services Company; and Cheryl Marks, GAI Consultants on March 26, 1996.

A Water Quality Monitoring Plan is enclosed. Water quality will be monitored using Groundwater Monitoring Wells 1R, 2, and 3 and Surface Water Locations 1 and 2 on Plate 1.

The monitoring wells for the groundwater quality monitoring system for the closed landfill were reviewed for location and integrity on March 26, 1996. Monitoring Well 2 is located in a berm. Soil needs to be removed from around the base of the well and the well fitted with a protective pipe or other protection to maintain its integrity. A well construction record for Groundwater Monitoring Well 1R along with a well construction sheet for Groundwater Monitoring Wells 2 and 3 is attached.

Sincerely,
GAI Consultants - NC, Inc.

Kathleen Armstrong for

Thomas J. Rossbach, Ph.D., L.G.
Staff Geologist

Wendell W. Parker

Wendell W. Parker, Ph.D., P.E.
Vice President

NORTH CAROLINA PROFESSIONAL SEAL 15945 ENGINEER WENDELL W. PARKER

Copy to: Wayne Sullivan, Municipal Engineering Services Company

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY	
QUAD. NO.	SERIAL NO.
Lat.	Long. / RO
Minor Basin	
Basin Code	
Header Ent.	GW-1 Ent.

WELL CONSTRUCTION RECORD

MW-R

DRILLING CONTRACTOR: GAI Consultants

DRILLER REGISTRATION NUMBER: 446

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Spruce Springs County: Avery
(Road, Community, or Subdivision and Lot No.)

2. OWNER Avery County
ADDRESS PO Box 640
(Street or Route No.)
Newland NC 28657
City or Town State Zip Code

3. DATE DRILLED 4-25-95 USE OF WELL Monitoring
4. TOTAL DEPTH 22'
5. CUTTINGS COLLECTED YES [ ] NO [x]
6. DOES WELL REPLACE EXISTING WELL? YES [x] NO [ ]
7. STATIC WATER LEVEL Below Top of Casing: 10.0 FT.
(Use "-" if Above Top of Casing)
8. TOP OF CASING IS +2.5 FT. Above Land Surface*
* Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
9. YIELD (gpm): N/A METHOD OF TEST
10. WATER ZONES (depth): 10.0 - 22.0

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0'	7.0'	Brown mica clayey silt
7.0'	22.0'	Saprolite, mica bandi few quartz
22.0		Bottom of boring

If additional space is needed use back of form

11. CHLORINATION: Type N/A Amount

12. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.5	7 Ft.	2"	Sch 40	PVC
		Ft.			
		Ft.			

13. GROUT:

	Depth From	Depth To	Material	Method
	4	5.6 Ft.	bentonite	pellets
	0	4 Ft.	neat cement	pour

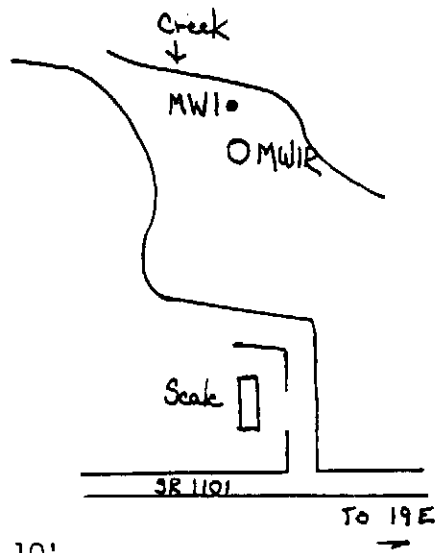
14. SCREEN:

	Depth From	Depth To	Diameter	Slot Size	Material
	7	22.0 Ft	2" in.	.010 in.	PVC
		Ft.	in.	in.	
		Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Size	Material
	5.6	22.0 Ft.		
		Ft.		

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



16. REMARKS: Monitoring Well 1R Water level approximately 10'

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Cheryl Marks 5-17-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

GW-1 REV. 9-91

... DOCUMENTATION SHEET LARRY ROSE

Date: 6-30-92 Site Name: Avery Co LF Site Desc.: Munic/Sani (munic.-indus./sani.-demo) District: W

Permit #: 06-01 County: AVERY Site Address: SR 1101 Site Contact:

Abbreviations: PVC = Polyvinylchloride; GS = Galvanized Steel; S = Steel; SS = Stainless Steel

	Type of Casing		Size of Casing		Depth From Top of Outer Casing		Feet of Standing Water	Stickup Height		Comments
	inner	outer	inner	outer	to Bottom	to Water		inner	outer	
MW 1	PVC	REPLACED S	2	4	23.80	8.82	14.98	14 3/4	14	- Nearly covered w/ fill dirt - no well cap - Downgradient + beside sed. basin - water clear - silt in bottom - unlocked - Pad not visible * Purges dry
MW 2	PVC	S	2	4	14.23	4.80	9.43	6	16	- nearly covered w/ fill dirt - Pad not evident - 42" to grout from top of outer casing - downgradient - purges down to dry - abundant red/brown bacteria - possible iron bact.
MW 3	PVC	S	2	4	14.21	5.30	8.91	13	12 1/2	- side gradient - purges dry - Water between casings - has pad - 44" to grout - flocculant material in water
										AL HETZELL
									DEM	HAROLD ROY DAVIS PAUL WHITE
										SPLIT SAMPLE - ENGINEERING TECHTONICS JEFF WYATT

WATER QUALITY MONITORING PLAN

INTRODUCTION

The objective of the water quality monitoring plan is to provide clear guidelines and procedures to be followed by field and laboratory personnel when obtaining and testing ground and surface water samples.

The goal of the sampling plan is to obtain the desired sample while neither adding nor subtracting any constituent to or from the sample or the monitoring well. The plan details described below, when followed, are considered adequate to eliminate any cross-contamination or contamination from external sources of the wells sampled. These guidelines are drawn, in part, directly from and are intended to be used in conjunction with the N.C. Water Quality Monitoring Guidance Document for Solid Waste Facilities (Guidance Document); a copy is in Appendix A.

The goal of the analysis plan is to test and detect, if present, selected chemical constituents in the ground and surface water. Testing will be conducted to the desired detection levels with accuracy and precision under controlled sampling and testing procedures such that chemical constituents not present are neither added to the water nor detected.

SAMPLING EQUIPMENT

Groundwater samples will be obtained in the field using a dedicated, laboratory-cleaned, stainless steel bailer. Each bailer will be cleaned in a laboratory controlled environment prior to sampling in accordance with the following steps.

1. Completely disassemble bailer.
2. Phosphate-free, laboratory grade soap and distilled water wash.
3. Distilled water rinse.
4. Isopropyl alcohol rinse.
5. Distilled water rinse.
6. Air dry.
7. Wrap bailer in aluminum foil, shiny side out.
8. Wrap bailer in plastic.

In addition to laboratory cleaned bailers for each well sampled, standard equipment necessary to conduct the sampling includes sample containers, including trip blanks and equipment blanks, wide-mouth container, at least two 600-ft spools of ¼-inch nylon rope, at least two boxes of latex gloves, one box of large plastic bags, temperature indicator, pH indicator, conductivity indicator, water level indicator, storage coolers, and ice. In case of emergency, supplies to clean bailers as described above may also be brought to the site. If the total depth of all wells to be sampled exceeds 1200 feet, additional spools of rope will be obtained to complete the sampling. If the

wells to be sampled exceeds 1200 feet, additional spools of rope will be obtained to complete the sampling. If the number of wells to be sampled exceeds one third of the number of pairs of gloves in stock, additional boxes of gloves will be obtained.

The bailers, wrapped in foil and plastic, will be transported between pieces of peaked foam rubber to prevent damage to the wrappings. Other equipment subject to damage and contamination will be transported in sealed, plastic bags. The water level indicator will be cleaned in accordance with Steps 2 and 3 described above prior to placement in a clean plastic bag.

SAMPLE CONTAINERS

Various sample containers are required for a complete sampling and analysis effort. Routine groundwater and surface water monitoring may include the following:

- Volatile organic analysis (VOA), and
- Inorganic analysis, such as heavy metals or general chemistry.

Samples will be collected for the various analyses in the containers described below in the order listed.

Samples to be analyzed for VOA will be collected first in four 40-ml glass vials with teflon caps. The sample vials will be completely filled with no air left in the vials.

Samples to be analyzed for inorganic contamination will be collected next in two 1-quart/1-liter plastic containers.

Samples to be analyzed for complete organics, including acid-base neutrals, will be collected in a ½-gallon/2-liter glass jar with aluminum foil or teflon-lined caps.

Samples to be analyzed for radiologic parameters will be collected next in 1-gallon/4-liter plastic containers.

Samples to be analyzed for bacteriological parameters will be collected in one 120-ml plastic vial.

All sample containers will be obtained from an independent laboratory in a sterilized condition. Some of the containers will have a premeasured amount of preservative in them as necessary. In this event, care will be taken not to rinse the container or allow the preservative to wash out during sampling.

GROUNDWATER SAMPLING

Preparation. Sampling a groundwater monitoring well begins with unlocking and opening the locking cap and removing the PVC well cap. The depth to water will be determined using the water level indicator. Before storage and/or reuse, the water level indicator will be cleaned in accordance with Steps 2 and 3 described above and replaced in a clean plastic bag.

The total well depth read from the well tag and the measured depth to water will be used to compute the depth of water in the well. The total well depth will be measured and compared to the depth indicated on the well tag as a check for siltation or blockage at depth. Using the chart in the Guidance Document, the volume of water in the well will be determined. For example, if a two-inch well is 29 feet deep and has a measured depth to water of 10 feet, there are 19 feet of standing water or 3.3 gallons in the well. Each well will be purged three to five well volumes (quantity of water in the well), or until dry, prior to sampling. In the example, 10 gallons would be adequate. Purged water will be measured in 5-gallon buckets until the desired amount is purged. Care will be taken not to bring the bailer into contact with the bucket during purging.

Based on the number of wells to be sampled and their proximity to each other, all the wells may be purged one after another with sampling to follow. In this manner, if a well is purged dry, it will have time to recharge prior to sampling.

Purging. After the amount of water to be purged from a well is determined, the equipment necessary for purging will be assembled at the well including rope, 5-gallon bucket, bailer, and gloves. With the wrapped bailer maintained in a stable, upright position, the top portion of aluminum foil will be pulled away exposing only the eyelet used for securing the rope to the bailer. After the rope has been secured to the bailer with gloved hands, the bailer will be suspended as the aluminum foil and plastic are removed. The gloved hand used to remove the aluminum foil and plastic will be considered contaminated and may not come into contact with the bailer or rope. The bailer will be lowered slowly into the well using the uncontaminated, gloved hand that suspended the bailer until the bailer contacts the water. The rope will be cut to an adequate length and secured to prevent losing the bailer in the well. The gloves will be discarded and a new pair used during the purging.

In order not to allow the rope to touch the ground during purging, the rope will be gathered when raising the bailer either by gathering in loops in one hand or by the wind mill method. The wind mill method requires hooking the rope with alternating thumbs as the rope is pulled from the well. When purging deep wells, the ground around the well head may be covered with a clean plastic bag or sheet of plastic with a slit cut to allow the plastic to slide over

the well head. The plastic will be placed over the sampler's boots to allow the rope to fall on the plastic without contamination. Alternatively, the rope may be lowered into an open bag placed in a 5-gallon bucket beside the well head. In any case, the rope will not contact anything considered contaminated including ground, boots, dirtied plastic, etc.

If purging and sampling of a well is performed at separate times, the bailer will be left suspended in the well above the water table and the rope secured. The remaining rope will be doubled and grasped in a tight loop in one hand. With the free hand, the glove on the hand holding the rope will be removed by pulling away from the hand and over the rope in an inside-out position until rope is encased in the glove. The rope will be transferred to the opposite hand and the procedure repeated to cover any portion of rope remaining uncovered. The glove-encased rope will be set on top of the well head until time to sample. Alternatively, the rope remaining after securing may be gathered in a tight loop and pushed into the 2-inch PVC well pipe and left. If sampling immediately follows purging, new gloves will not be necessary.

Equipment Blank. Prior to sampling the wells, an equipment blank will be prepared using a representative bailer. This procedure entails removing the top and bottom portions of the aluminum foil while sustaining the bailer in one hand, removing the lid of the bailer and filling with distilled water, and replacing the lid. The distilled water is then dispensed through the small holes at the top of the bailer into the appropriately labeled equipment blank containers.

Sampling. Prior to sampling the well, the necessary equipment will be assembled at the well, including pH, conductivity, and temperature indicators, sampling jars, a thoroughly cleansed wide mouthed container, and a box of latex gloves.

With gloves on, the bailer will be lowered into the well slowly. To avoid releasing any volatiles from the groundwater, care will be exercised while the bailer is lowered so that it does not splash or smack the water surface. Once full, the bailer will be retrieved and containers filled in the order described above. The containers will be filled by inverting the bailer until water issues from the small holes at the top of the bailer. In addition to collecting the samples, water will be collected in the wide-mouth container for pH, temperature, and conductivity measurements. The pH, temperature, and conductivity indicators and wide-mouth container will be rinsed with distilled water after sampling each monitoring well and will be cleaned in accordance with Steps 2 through 5 above at the completion of the project.

Following completion of the sampling, the containers, including the equipment blank and trip blank, will be stored

and transported on ice. The used latex gloves and rope will be discarded.

SURFACE WATER SAMPLING

Surface water samples will be obtained from adjacent rivers, streams, or brooks upstream and downstream of the landfill at designated surface water sampling sites. Actual collection points for surface water sampling will be selected with consideration given to minimal turbulence and aeration.

Surface water sample containers will be handled with one hand near the base. The container will be rinsed with the water to be sampled prior to filling the container unless the container contains a premeasured amount of preservative. When collecting surface water samples, sample containers will be dipped at location points with extreme caution in order to avoid contamination at the mouth of the container. The container will be pushed rapidly into the water to a depth of about six inches, mouth down, and tilted towards the stream current to fill. Care will be taken not to let the mouth of the container breech the surface while filling. If there is little current movement, the container will be moved slowly through the water laterally. During times of drought, if the water is not deep enough to allow submersion of the container, a pool may be scooped out of the bottom of the stream to obtain a sample. The pool will be allowed to clear before sampling. The container will be lifted from the water and sealed with the cap, leaving an airspace at the top of about ½ inch. Glass vial containers collected for VOA and TOX analyses will be filled completely as described above. The samples will be stored and transported on ice.

SAMPLE TRANSPORT AND CHAIN-OF-CUSTODY

Sample containers will be clearly labeled as the samples are obtained and stored on ice along with the equipment blanks and trip blanks. Trip blanks will remain in the condition they are received from the laboratory and will not be opened or tampered with during the sampling. A chain-of-custody record will be completed for each day's samples, indicating the date and time, sample location, sample matrix (soil, water, etc.), and laboratory analyses to be conducted. In addition, a field sampling data sheet will be completed indicating the depth to water measured in each well sampled and the pH, temperature, and specific conductivity of the sample measured in the field. Sample copies of the chain-of-custody record and field sampling data sheet are in Appendix B.

GROUND AND SURFACE WATER ANALYSIS

Water samples obtained in the field will be maintained in the sample containers on ice and transported to an approved laboratory for analysis. If the individual transporting the samples is different from the individual that did the sampling, the chain of custody forms will be used to document the transfer of custody from the water sampler to the water transporter. When the water samples reach the laboratory, they will be transferred to a sample

custodian who will sign the chain of custody documentation for receipt of the samples. Internal control of the water samples in the laboratory will be in accordance with QA/QC procedures for the laboratory. Copies of QA/QC manuals for approved laboratories are on file with the Division of Solid Waste.

Ground and surface water samples will be analyzed for the list of chemical constiuents in Table 1 using the EPA methods shown. References where these test methods are documented are also presented in Table 1. In addition, practical quantitation limits for each of the constituents and a list of the equipment that will be used in the laboratory testing are presented in Table 1. QA/QC procedures utilized during the testing will be in conformance with the laboratory QA/QC manual.

TABLE

TABLE 1
GROUND AND SURFACE WATER ANALYSES METHODOLOGY

Inorganic Constituent	Test Method	Equipment	PQL, μg/L
Arsenic	EPA 7060A	GF/AA	10
Barium	EPA 6010A	ICP	500
Cadmium	EPA 7131A	GF/AA	1
Chromium	EPA 7191	GF/AA	10
Lead	EPA 7421	GF/AA	10
Mercury	EPA 7470	GF/AA	1
Selenium	EPA 7740	GF/AA	20
Silver	EPA 7761	GF/AA	10
Organic Constituent			
Acetone	EPA 8260	GC/MS	100
Acrylonitrile	EPA 8260	GC/MS	200
Benzene	EPA 8260	GC/MS	5
Bromochloromethane	EPA 8260	GC/MS	5
Bromodichloromethane	EPA 8260	GC/MS	5
Bromoform	EPA 8260	GC/MS	5
Carbon disulfide	EPA 8260	GC/MS	100
Carbon tetrachloride	EPA 8260	GC/MS	10
Chlorobenzene	EPA 8260	GC/MS	5
Chloroethane	EPA 8260	GC/MS	10
Chloroform	EPA 8260	GC/MS	5
Dibromochloromethane	EPA 8260	GC/MS	5
1,2-Dibromo-3-chloropropane	EPA 8260	GC/MS	25
1,2-Dibromoethane (Ethylene dibromide)	EPA 8260	GC/MS	5
1,2-Dichlorobenzene	EPA 8260	GC/MS	5
1,4-Dichlorobenzene	EPA 8260	GC/MS	5
trans-1,4-Dichloro-2-butene	EPA 8260	GC/MS	100
1,1-Dichloroethane	EPA 8260	GC/MS	5
1,2-Dichloroethane	EPA 8260	GC/MS	5
1,1-Dichloroethylene	EPA 8260	GC/MS	5
cis-1,2-Dichloroethylene	EPA 8260	GC/MS	5
trans-1,2-Dichloroethylene	EPA 8260	GC/MS	5
1,2-Dichloropropane	EPA 8260	GC/MS	5

TABLE 1
(continued)

Organic Constituent	Test Method	Equipment	PQL, µg/L
cis-1,3-Dichloropropene	EPA 8260	GC/MS	10
trans-1,3-Dichloropropene	EPA 8260	GC/MS	10
Ethylbenzene	EPA 8260	GC/MS	5
2-Hexanone	EPA 8260	GC/MS	50
Methyl bromide	EPA 8260	GC/MS	10
Methyl chloride	EPA 8260	GC/MS	10
Methylene bromide	EPA 8260	GC/MS	10
Methylene chloride	EPA 8260	GC/MS	10
Methyl ethyl ketone	EPA 8260	GC/MS	100
Methyl iodide	EPA 8260	GC/MS	10
4-Methyl-2-pentanone	EPA 8260	GC/MS	100
Styrene	EPA 8260	GC/MS	10
1,1,1,2-Tetrachloroethane	EPA 8260	GC/MS	5
1,1,2,2-Tetrachloroethane	EPA 8260	GC/MS	5
Tetrachloroethylene	EPA 8260	GC/MS	5
Toluene	EPA 8260	GC/MS	5
1,1,1-Trichloroethane	EPA 8260	GC/MS	5
1,1,2-Trichloroethane	EPA 8260	GC/MS	5
Trichloroethylene	EPA 8260	GC/MS	5
Trichlorofluoromethane	EPA 8260	GC/MS	5
1,2,3-Trichloropropane	EPA 8260	GC/MS	15
Vinyl acetate	EPA 8260	GC/MS	50
Vinyl chloride (Chloroethylene)	EPA 8260	GC/MS	10
Xylenes	EPA 8260	GC/MS	5

Legend

PQL	Practical Quantitation Limit
ICP	Inductively Coupled Plasma - Atomic Emission Spectrophotometer
GF/AA	Graphite Furnace - Atomic Absorption Spectrophotometer
GC/MS	Gas Chromatograph - Mass Spectrometer

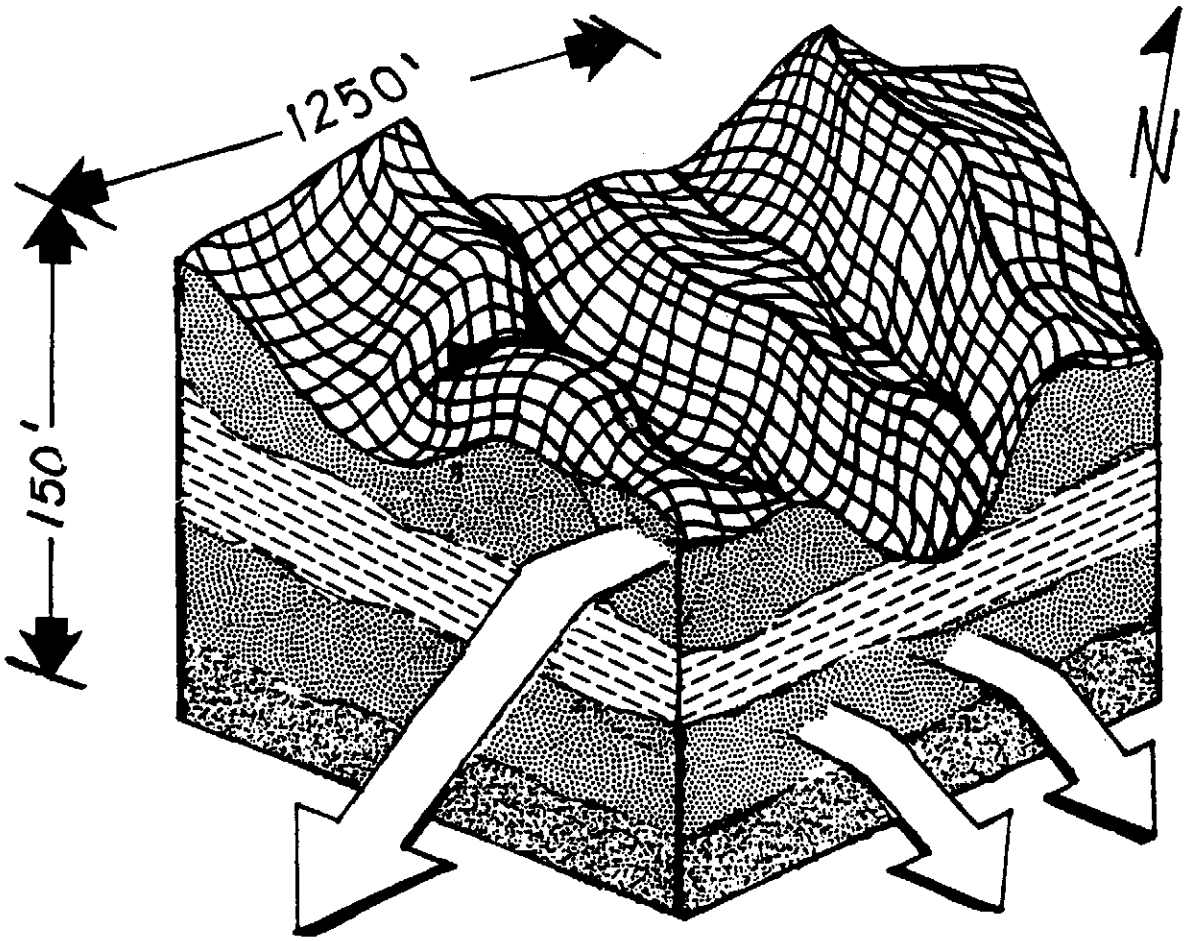
Note: 1. EPA Test Methods from "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," U.S. EPA Publication SW-846, 3rd Edition, September 1986, Amended by Update I, July 1992. Update I methods are designated with the letter "A" on the end of the method numbers. Update I was promulgated by 58 FR, August 31, 1993.

PLATE

APPENDIX A

N.C. WATER QUALITY MONITORING GUIDANCE DOCUMENT

NORTH CAROLINA WATER QUALITY
MONITORING GUIDANCE DOCUMENT FOR SOLID WASTE FACILITIES



GROUND-WATER FLOW DIRECTION OF UPPER AQUIFER

GROUND-WATER FLOW DIRECTION OF LOWER AQUIFER

Prepared by the
SOLID & HAZARDOUS WASTE MANAGEMENT BRANCH
ENVIRONMENTAL HEALTH SECTION
DIVISION of HEALTH SERVICES
DEPARTMENT of HUMAN RESOURCES
1987
SW-1001-87

NORTH CAROLINA WATER QUALITY
MONITORING GUIDANCE DOCUMENT FOR SOLID WASTE FACILITIES

Prepared by the
SOLID & HAZARDOUS WASTE MANAGEMENT BRANCH
ENVIRONMENTAL HEALTH SECTION
DIVISION of HEALTH SERVICES
DEPARTMENT of HUMAN RESOURCES

1987

SW-1001-87

LIST OF FIGURES

FIGURE PAGE

1. Typical Ground-Water Monitoring Well Schematic Diagram 2
2. Graphical Plot of Standing Water Volumes 4
3. Laboratory Analysis Request Sheet 9
4. Chain of Custody Form 10
5. Typical Ground-Water Monitoring Well Nest Schematic 14

TABLE OF CONTENTS

PAGE

ACKNOWLEDGEMENTS i
DEFINITIONS ii
GENERAL INTRODUCTION iii
INTRODUCTION 1
SPECIFIC MONITORING WELL CONSTRUCTION REQUIREMENTS 1
GROUND-WATER MONITORING 5
PORTABLE MONITORING 5
PURGING METHODS 5
SAMPLING METHODS 6
DEDICATED MONITORING 7
EQUIPMENT CLEANING PROCEDURES 7
SAMPLE CONTAINERS 8
TRANSPORT AND STORAGE OF SAMPLES 11
ADMINISTRATIVE PROCEDURES 11
SURFACE WATER MONITORING 12
FRACTURED WATER MONITORING 13
REFERENCES CITED 16

--ACKNOWLEDGEMENTS--

The following individuals are acknowledged for their constructive suggestions and input regarding this document: Gary Babb, Bob Glaser, and Paula Byrd. Additionally, the comments and feedback from Nathaniel Wilson and Ray Porter are also greatfully acknowledged. Last but not least, the assistance of Michelle Johnson and Lynelle Parrish in preparing the draft is warmly appreciated.

Michael L. Babuin, 1987

DEFINITIONS

Monitoring Well - any well constructed for the primary or incidental purpose of obtaining subsurface samples of water or other liquids. This definition excludes lysimeters, tensiometers, and other devices used to investigate the characteristics of the unsaturated zone.

Observation Well - any well constructed for the purpose of obtaining ground-water level information only

Permittee - an individual, corporation, company, association, partnership, unit of local government, State agency, Federal agency or other legal entity upon which a permit to operate a sanitary landfill has been issued.

Water Table - the upper limit of the portion of the ground wholly saturated with water.

GENERAL INTRODUCTION

The purpose of this report is to provide a simple, clear and thorough overview of acceptable methods regarding ground and surface-water monitoring at solid waste facilities. The procedures and techniques outlined in this report have been compiled in response to the need for reliable, accurate and consistent data for ground-water and surface-water quality evaluation of sanitary landfills. The standardization of these methods of data collection will undoubtedly clarify proper ground-water monitoring techniques required by the State for all solid waste facilities, and subsequently, minimize much of the subjectivity associated with landfill evaluation. Clearly, it is in the best interests of each facility to utilize these guidelines whereas the probability of contamination is significantly reduced by following the steps outlined in this document.

INTRODUCTION

In order to fully acknowledge the scope and purpose of ground-water monitoring, it is of the utmost importance to fully understand and define the difference between a ground-water monitoring well and a public water supply well. This distinction is very obvious when comparing well construction techniques characteristic of various geologic formations throughout the State. For instance, the western part of North Carolina is dominated by a series of crystalline and metamorfic rocks. Subsequently, water supply wells in these regions typically are constructed by drilling through the saprolite (weathered rock) and into very hard, resistant rock bodies below the true water table. Because of the resistant lithologic character of these units, many well drillers feel that it is unnecessary to case a well characteristic of these type of conditions. This rationale may hold true for drinking water supply wells but is clearly unacceptable for ground-water monitoring purposes due to contamination problems associated with uncased or partially-cased holes and to possible logistic problems. For instance, monitoring equipment may become entangled on the bottom of a well casing which does not span the entire depth of the borehole. Subsequently, this office requires completely cased boreholes in all ground-water monitoring wells.

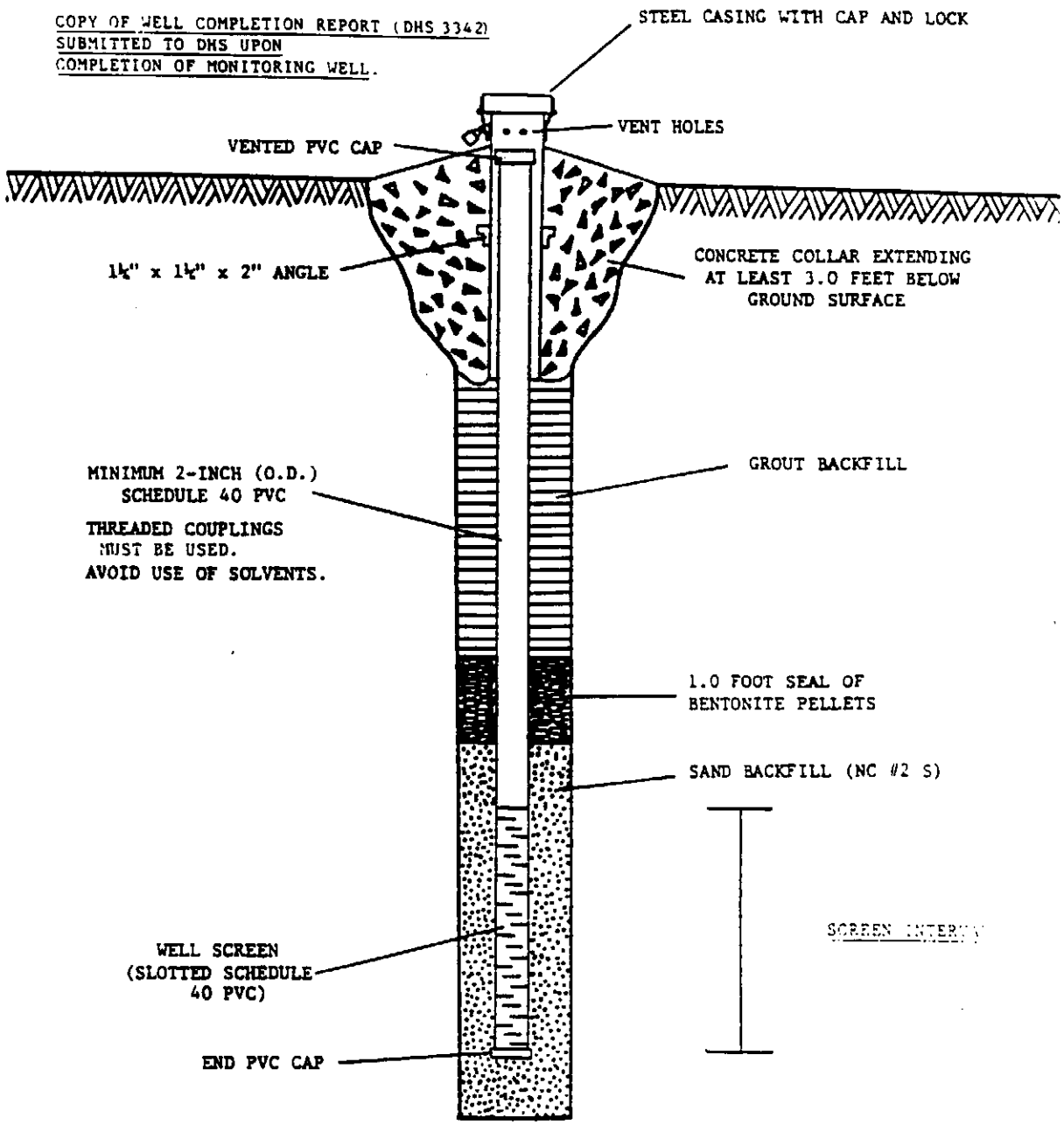
This office strongly urges all contractors and consultants to become familiar with well construction techniques and specifications illustrated on the ground-water monitoring well schematic (Figure 1). Further information regarding construction standards of other types of wells may be found in 15 NCAC 2C "Well Construction Standards: Criteria and Standards Applicable to Water Supply and Certain Other Types of Wells".

A. Specific Monitoring Well Construction Requirements

Because the location of ground-water monitoring wells at the proposed landfill is one of the most crucial phases of site development, the importance of a thorough hydrogeologic evaluation which clearly delineates ground water elevation and flow characteristics is of the highest significance. In order to assure consistent and thorough installation techniques which are in accordance with EPA regulations, all deviations to the following methods, or questions regarding materials, monitoring well locations or other techniques, should be directed to the Solid Waste Hydrogeologist at (919) 733-2178, c/o the Solid and Hazardous Waste Management Branch P.O. Box 2091 Raleigh, North Carolina 27602-2091. Additionally, the Solid and Hazardous Waste Management Branch reserves the right to evaluate in the field, the actual well installation techniques and procedures.

Drilling through the unsaturated soil mantle to the water bearing formation is a standard procedure with most consulting and well-drilling firms. Utmost caution and discretion in minimizing the use of drilling fluids (bentonite-gel mixture), flocculants (mixtures of sodium pyrophosphate) and excessive use of lubricants is highly recommended. If any of these products, or related products, are used in the drilling process the hole should be flushed to remove as much of the contaminants as possible.

Installation of the monitoring well and subsequent placement of the well screen is critical to assure that the ground water sample represents the



Rev. 5/86

Figure 1. Typical ground-water monitoring well schematic diagram.

portion of the aquifer where contaminants may migrate. The minimum length of the screened interval is 10 feet and will be placed at a depth specified as a condition of the permit based upon hydrogeologic data collected during the site investigation. Recommended screen depths will be submitted by the applicant under the heading "proposed comprehensive ground-water monitoring plan" as part of the site plan application as per section .0504 (1)(G)(iv). Well-sorted sand used as a pre-screening of influent ground water should be washed to remove all fines and prevent clogging of the well screen. Finally, in connecting sections of PVC pipe, clamps or threaded pipe fittings are required whereas various types of epoxy cement and other PVC glues have the potential for contaminating the ground-water reservoirs. For these reasons they are not authorized for construction of ground-water monitoring wells.

Various drilling methods and casing sizes are available for installation of monitoring wells. Generally, the most common size bore holes include those which are drilled with an eight inch hollow-stem auger. The casings which are placed in these holes are typically 4" or 2" I.D., and composed of PVC, stainless steel or teflon materials. For reasons which are discussed later under the "Ground-Water Monitoring" heading, this office recommends the use of 2" I.D. casings for wells drilled 100' or less. Ground-water monitoring wells drilled to depths exceeding 100' such as wells designed to monitor water quality through possible fracture patterns, should be cased with a 4" or 6" I.D. casing to readily promote rapid purging via jet pumps. Casings and screens may be composed of PVC or stainless steel. Teflon casings and screens are relatively maleable and may not hold-up under various conditions.

As mentioned above, this office recommends the installation of 2" I.D. cased wells for shallow and semi-shallow ground-water monitoring purposes. The use of 2" I.D. casings readily promotes rapid purging via teflon bailers. For example, a 2" I.D, cased well drilled 20 feet deep may contain up to approximately 3.3 gallons of standing water. Because three to five times the volume must be purged to avoid contamination (EPA, 1977), it is foreseeable that 9.9 to 16.5 gallons of water must be purged prior to sampling (Figure 2) in the above example. Assuming a purging minimum of 9.9 gallons of water, and also assuming that a 3' long bailer (which holds 1-liter of water) will be used for purging of the wells, it will take approximately 40 bails of water to adequately purge this well. Comparatively, a 4" I.D. cased well drilled to an extremely shallow depth of 16' will contain approximately 10.5 gallons of water, and subsequently, require between 31.5 and 52.5 gallons of purged water. Attempts to purge 52.5 gallons of water with a 1-liter bailer will require 210 bails of water-- which will undoubtly displease the field personnel and more importantly, occupy additional hours of expensive and needless labor as well.

An obvious difference shown on the schematic of a typical ground-water monitoring well (Figure 1), compared to other types of wells, is the concrete collar surrounding the stick-up (or outer casing) above the ground surface. This collar should contain small angle-irons attached to the outer casing as outlined on the diagram (Figure 1). The purpose of this set-up is to prevent accidental (or willfull) damage to the well whereas the stick-up could otherwise be pulled loose at the surface without the use of angle-irons to support the collar.

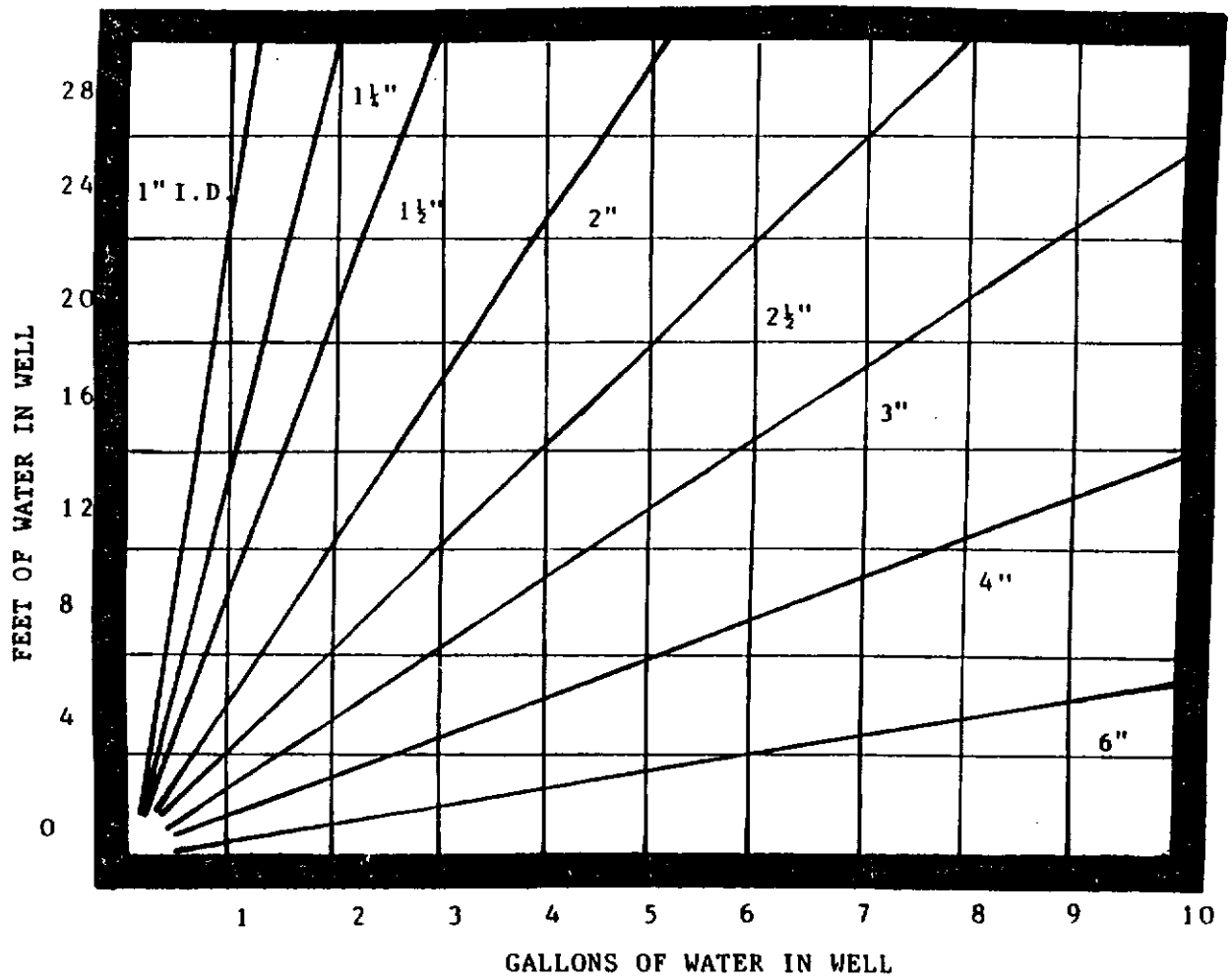


Figure 2. Graphical plot of standing volumes of water.

Because accidental or natural events may influence the status and condition of pre-existing ground-water monitoring wells, an on-going well inspection program is being conducted by personnel of the Solid andHazardous Waste Management Branch. Some of the items which must be regularily maintained by the facility after the wells are installed include: 1) ensuring that all caps are rust-free and locked at all times, 2) ensuring that all inner casings are securely fit with a threaded cap, 3) ensuring that the outer casing is upright and undamaged from equipment or vehicles which may inadvertently back-up into the well, 4) ensuring that a clear unobstructed path, free from dense vegetation exists leading to each well. These maintenance factors are critical to the implementation of proper ground-water monitoring.

B. Ground-Water Monitoring

Because a tremendous liability is associated with water quality data obtained from analytical laboratory results, it is of the utmost importance to ensure the validity and integrity of sampling techniques and methodology. Two distinct monitoring systems exist which may be used to purge and subsequently sample a monitoring well. These systems include the portable monitoring system and the dedicated monitoring system.

Portable Monitoring

The portable monitoring system is by far the most common method of monitoring ground-water quality. This method includes purging the total standing water within the well and subsequent sampling of a representative portion of the aquifer. Purging is required in all instances in order to avoid sampling of stagnant, possibly stratified water above the well screen. In many cases, however, the recharge rate may meet or exceed the purging rate. For these instances three to five times the volume of standing water must be purged prior to sampling. Several methods exist for removing the standing water within a well. Among these methods are various types of automated pumps, compressed air, hand pumps and bailers, each of which has several advantages and disadvantages which will be discussed below.

In some instances dependant upon the hydrogeologic setting, the recharge rate may be exceptionally slow (EPA, 1977), subsequently, sampling may not be possible until the next day when the well is recharged. Generally however, all attempts should be made to purge the wells dry or purge until the necessary three to five times the well volume is extracted. In other settings where the soils are relatively permeable purging and subsequent sampling may be possible in the same day.

1. Purging Methods

Depending upon time constraints and spatial variability of the monitoring wells, the decision whether to purge and sample a facility on the same day must be made by the field personnel performing the monitoring operation. Additional concerns regarding the depth of the well, water volumes, well access and inclement weather are all important in determining which type of device to use in purging the well. For instance, if fully automated, effortless purging is desired and time is not a major concern, the use of an automated pump may be in order. The major disadvantage of

these pumps, however, include slow pumping rates (typically a maximum of 0.5 gallons/minute) and the potential for cross contamination from well to well.

The hand pump is another type of purging device which is available invarious lengths and pumping rates (typically 2.75 gallons/minute). This device has the advantage of easy assembly, low cost and relatively high pumping rates. An obvious disadvantage, however, is the need for a thorough cleaning in the field before purging from one well to the next.

Another popular purging device is the teflon bailer. Teflon is considered to be the preferred material to use for ground water monitoring because of its relatively inert chemical character. Stainless steel is also an acceptable purging/sampling mechanism for similar reasons. Regardless of the composition, bailers are available in various lengths, the most popular being the 3' bailer which holds a volume of water equal to 1 liter or 0.26 gallons.

2. Sampling Methods

Thus far the focus of this discussion has primarily been upon purging techniques, subseqently, a short discussion which addresses sampling procedures is now in order. The use of automated pumps for sampling purposes requires considerable effort to avoid contamination. Many automated pumps are designed to remain on the ground surface while a specified length of flexible tubing is placed into the well. For sampling purposes if this technique is to be used, it is mandatory that the flexible tubing be composed of teflon and adequately cleaned prior to sampling from one well to another. The inevitable question arises, however, whether or not adequate cleaning is possible in the field for these types of automated pumps.

Because laboratory analyses evaluate water quality in terms of parts per million and parts per billion, it is not recommended to clean and prepare sampling devices in the field when a laboratory cleaning will undoubtedly produce a higher quality final product. Other types of automated pumps (called bladder pumps) are designed to fit down the borehole and are typically composed of teflon and stainless steel. One inherent difficulty associated with some bladder pumps in addition to possible sample contamination problems is the inability of many bladder pumps to adequately control and regulate the rate at which the flow of water leaves the flexible tubing. This is critical for samples to be analyzed for volatile organic analysis (VOA) whereas a rapid flow rate will cause aeration which subsequently volatilizes certain chemicals. For these reasons this office urges that the utmost consideration and thought be given to the feasibility of whether or not to utilize traditional automated pumps for sampling purposes.

Hand pumps are useful tools for purging wells in a relatively short period of time but, unfortunately, are highly unsuitable for sampling. The main reason being the likelihood of contamination and the unavailability of teflon or stainless steel hand-pumps in the commercial market. Additionally, no present technology exists for regulating the effluent discharge of water from a hand pump which, as mentioned before, presents a volatilization problem for certain samples.

The overall preferred method of acquiring ground-water samples via portable monitoring is by the use of telfon bailers. In a properly established and equipped laboratory setting, a standardized cleaning and preparation procedure may be followed. The obvious advantage of laboratorycleaning includes minimal generation of contaminants and consistency in preparatory procedures.

Dedicated Monitoring

Thus far the previous discussions have all focused upon techniques and procedures related to portable ground-water monitoring systems. At this time, a short overview of dedicated systems is in order. Dedicated well monitoring differs from portable monitoring primarily by the permanency of the set-up and the higher initial cost. Because portable systems require the use of much of the same equipment from well to well, great care must be exercised in avoiding cross contamination. Dedicated systems, however, require no between-well cleaning procedures. These systems offer permanently affixed down-well and well-head components which are capped after initial set-up.

Because ground water is not in contact with incompatible constituents that otherwise may enter the well from the surface, virtually no contamination is possible from an extrinsic source during times between sampling intervals. As with all sampling methods the competency and integrety of the individual extracting the sample is of the utmost importance. For instance, a great deal of manual dexterity must be exercised in regulating the flow of water leaving the flexible tubing from dedicated systems when collecting VOA samples in order to avoid unnecessary volatilization. In conclusion, dedicated systems have the potential for accurate and reliable ground-water monitoring and are therefore recommended for consideration.

In contrast to this, many individuals are under the false impression that bailers which are initially cleaned in a laboratory and permanently placed in monitoring wells are considered dedicated systems and subsequently are acceptable for ground-water monitoring purposes. Unfortunately, this is not true due to the possibility of extrinsic contamination during sampling intervals, such as decomposition of the bailer line, airborne dirt and dust, or other accidentally induced contaminants. Because the detection limits for the various parameters are measured in terms of parts per million and parts per billion, the utmost discretion is required in selecting sampling procedures which will accomodate these analyses.

1. Equipment Cleaning Procedures

If automatic pumps and flexible tubing are used, a minimum field cleaning procedure will entail using a phosphate-free soap/deionized water solution followed by a deionized water rinse. This method constitutes an absolute minimum field cleaning procedure and should only be used if sampling one G.W. monitoring well. These pumps are not recommended or authorized for sampling more than one well due to probable contamination problems.

Stainless steel bailers require the following minimum cleaning techniques prior to groundwater sample collection:

1. Phosphate-free soap and tap water wash
2. Tap-water rinse
3. Deionized or distilled water rinse
4. Isopropyl alcohol rinse
5. Deionized or distilled water rinse
6. Air dry
7. Wrap bailer to prevent contamination before use (specify the material used for wrapping the bailer, example: aluminum foil shiny side out).

Teflon bailers require the following minimum cleaning techniques prior to ground water sample collection:

1. Phosphate-free soap and tap water wash
2. Tap water rinse
3. 10% nitric or 10% hydrochloric acid rinse
4. Deoinized or distilled water rinse
5. Isopropyl alcohol rinse
6. Deionized or distilled water rinse
7. Air dry
8. Wrap to prevent contamination before use (specify material used for wrapping for wrapping the bailer, example: aluminum foil, shiny side out).

The bailer line which attaches to the teflon or stainless steel bailers should consist of either 1) teflon coated wire, 2) single-strand stainless-steel wire, 3) other monofilament line or 4) nylon rope. In order to avoid contamination, a new segment of one of the above approved types of line should be used at each well. Reusing old line will increase the probability of cross contamination (even if the line is cleaned) and therefore is not approved. Any variation to the above cleaning procedures should be submitted to this office for approval.

Condition

The above cleaning procedures were obtained from EPA Region IV. If changes occur in any procedure specified above, the facility will be notified and be requested to make the necessary ammendments to the sampling and analysis plan.

Sample Containers

Because water samples are analyzed for various parameters, several types of containers are required for a complete sampling scheme. Routine ground-water monitoring should include (in the following order as extracted from the well): 1) VOA samples (for TOX analysis), and 2) heavy metal (inorganic) analysis. If additional analyses are required, the samples should be collected in the order listed below.

For instance, samples which are analyzed for volatile organic analysis (VOA) and/or total organic halogens (TOX) should be collected first in 40 ml glass vials with teflon caps. Two full vials per sample are required.

N. C. Department of Human Resources
Division of Health Services

SAMPLE ANALYSES REQUEST

State Laboratory of Public Health
P. O. Box 28047
306 N. Wilmington Street
Raleigh, 27611

Site Number _____ Field Sample Number _____

Name of Site _____ Site Location _____

Collected By _____ ID# _____ Date Collected _____ Time _____

Type of Sample:

Environmental	Concentrate	Comments
____ Groundwater (1)	____ Solid (5)	_____
____ Surface Water (2)	____ Liquid (6)	_____
____ Soil (3)	____ Sludge (7)	_____
____ Other (4)	____ Other (8)	_____

INORGANIC CHEMISTRY

Extractables		Total			
Parameter	Results mg/l	Parameter	Results mg/l	Parameter	Results mg/l
____ Arsenic	_____	____ Arsenic	_____	____ Silver	_____
____ Barium	_____	____ Barium	_____	____ Sulfates	_____
____ Cadmium	_____	____ Cadmium	_____	____ Zinc	_____
____ Chromium	_____	____ Chloride	_____	____ Ph	_____
____ Lead	_____	____ Chromium	_____	____ Conductivity	_____
____ Mercury	_____	____ Copper	_____	____ TDS	_____
____ Selenium	_____	____ Fluoride	_____	____ TOC	_____
____ Silver	_____	____ Iron	_____	____ _____	_____
____ _____	_____	____ Lead	_____	____ _____	_____
____ _____	_____	____ Manganese	_____	____ _____	_____
____ _____	_____	____ Mercury	_____	____ _____	_____
____ _____	_____	____ Nitrate	_____	____ _____	_____
____ _____	_____	____ Selenium	_____	____ _____	_____

ORGANIC CHEMISTRY

Parameter	Results mg/l	Parameter	Results mg/l	Parameter	Results mg/l
____ P&T:GC/MS	_____	____ EDB	_____	____ Methoxychlor	_____
____ Acid:B/N Ext.	_____	____ PCB's	_____	____ Toxaphene	_____
____ TOX	_____	____ Petroleum	_____	____ 2,4-D	_____
____ _____	_____	____ Endrin	_____	____ 2,4,5-TP (silvex)	_____
____ _____	_____	____ Lindane	_____	____ _____	_____

MICROBIOLOGY

Parameter
____ (MF) Coliform Colonies/100mls
____ (MPN) Coliform Colonies/100mls
____ _____
____ _____

RADIOCHEMISTRY

Parameter	Results PCi/l
____ Gross Alpha	_____
____ Gross Beta	_____
____ _____	_____
____ _____	_____

Date Received _____ Date Reported _____

Date Extracted _____ Date Analyzed _____

Reported By _____ Lab Number _____

DHS 3191 (Revised 7/85)
Solid and Hazardous Waste (Review 7/87)

Figure 3. Laboratory analysis request sheet.

Chain of Custody Record

Solid & Hazardous Waste Materials

cation of Sampling: _____Generator _____Transporter _____Treatment Facility

_____Storage Facility _____Disposal Facility _____Landfill

_____Other: _____

mpany's Name _____ Telephone(_____)_____

ldress _____

llector's Name _____ Telephone(_____)_____
signature

ite Sampled _____ Time Sampled _____

pe of Process Generating Waste _____

ield Information

_____

_____

ield Sample No. _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____

nain of Possession:

. _____ _____ _____
signature title inclusive dates

. _____ _____ _____
signature title inclusive dates

. _____ _____ _____
signature title inclusive dates

esults reported

_____ _____ _____
signature title date

nstuctions: Complete all applicable information including signature, and submit with analysis request forms.

Figure 4. Chain of custody record.

Samples which will be analyzed for inorganic constituents such as heavy metals should be collected following the VOA samples. These samples are collected in small, disposable, 1-quart/1-liter plastic cubes. Two full cubes per sample are required. Depending upon the source of the sample containers, particularly, containers which hold water to be analyzed for heavy metals, some containers may have a pre-measured amount of acid placed in the container to act as a preservative. In these instances do not rinse the sample container prior to use, if uncertain, consult the laboratory where the containers were purchased.

If organic contamination is suspected it may be necessary to undergo a complete organic analysis. In this event, samples which will be analyzed for organics such as an acid-base neutral analysis should be collected in one half gallon/2-liter glass jars with aluminum foil or teflon lined caps. Samples to be tested via acid-base neutral analysis require one full jar of water per sample.

Water samples to be analyzed for radiologic parameters should be collected following acid-base neutral collection. These samples must be collected in the large 1-gallon/4-liter plastic cubes.

Finally, samples which will be analyzed for bacteriological parameters should be collected last in 120ml plastic vials containing a pre-measured amount of sodium thyosulphate. One vial per sample is required to perform the analysis.

Transport and Storage of Samples

Upon completion of water sample collecting all samples will be stored and subsequently transported on ice or in a refrigerated state to the laboratory performing the analyses (APHA, 1985; EPA, 1977). The samples should be stored in such a manner as to inhibit breakage or accidental spills. Unless unusually extraordinary circumstances prevent otherwise, all samples should be delivered to the laboratory on the same day.

Administrative procedures

Samples are to be delivered to a State Certified Drinking Water Laboratory and need to be accompanied by two administrative forms. The first form is a laboratory analysis request sheet (Figure 3). This form stipulates which constituents are to be analyzed for a given sample. The other form is a chain of custody record sheet (Figure 4). This form documents who handled the sample from collection time to lab delivery. These forms (or equivalents) will be submitted to the solid waste hydrogeologist within 15 days of receipt of the analytical results.

Per 10 NCAC 10G section .0601 (a), routine ground-water monitoring shall be the responsibility of the permittee and may be State supervised at the discretion of the Division of Health Services. An exception to this being the initial sampling of newly constructed wells by personnel of the Division of Health Services. Additionally, the State may request "split" or replicate samples from the facility during any of the routine sampling intervals.

Routine ground-water monitoring which encompasses the parameters listed below shall be conducted twice during the first year of operation (for newly-permitted sites) and annually thereafter. Newly-permitted facilities are required to properly install all proposed ground-water monitoring wells and subsequently notify the State within 30 days upon completion, so that the Division of Health Services may schedule a date to initially sample the wells. As mentioned above, subsequent sampling is the responsibility of the facility. All pre-existing (permitted) facilities as of July 1, 1987 are responsible for annual ground-water monitoring activities, and shall forward a copy of the analytical laboratory results within 15 days upon receipt to the solid waste hydrogeologist P.O. Box 2091, Raleigh, North Carolina 27602-2091 c/o the Solid and Hazardous Waste Management Branch.

All facilities (newly-permitted and pre-existing) shall send written notice by July 1, 1987 designating a tentative, annual sampling date for their facility. The purpose of which is to inform State personnel as to a specific date that they may expect the annual water quality results and to accomodate scheduling purposes by State personnel.

The following total inorganic parameters will be included for routine, annual ground-water quality analysis: arsenic, barium, cadmium, chloride,chromium, copper, fluoride, iron, lead, manganese, mercury, nitrate, selenium, silver, sulphates and zinc. The following indicators should be included in all routine, annual ground-water analysis : TOX (total organic halogens), TOC (total organic carbon, TDS (total dissolved solids), BOD (biological oxygen demand), COD (chemical oxygen demand), conductivity and PH. In the event that a contaminant plume is indicated by routine analysis of the monitoring wells, further analysis may be required to adequately assess contaminant migration and extent. Such anaysis may include purge and trap analysis (utilizing the gas chromatograph and mass spectrometer) and acid base-neutral extraction. Finally, a broad level of consistency should be exercised in listing the various quanities of chemical constituents. For instance, units should be PPM (parts per million) or PPB (parts per billion) not both. It is suggested tht parts per million (PPM) be used whenever possible.

C. Surface-Water Monitoring

Sites which contain and/or border small rivers, streams or branches should include within the site plan application, a prospective surface water monitoring plan. This plan will be used to gauge the effect of the landfill upon surficial flow at a given point. A simple procedure for selecting surface-water monitoring sites is to locate a point on the stream where drainage leaves the site. This promulgates detection of contamination through, and possibly downstream, of the site via discharge of surface waters. The sampling points selected should be downstream from any new, old or proposed areas which may be disturbed, including borrow and rubble areas (Babb and Glaser, 1985). An upstream surface water sample should be obtained in order to determine the water quality upstream of the influence of the sanitary landfill.

The following procedure is recommended regarding sample collection of surface water samples. Prior to collecting the sample in the appropriate

container, specific collection points should be determined. Generally, automated or semi-automated samplers or other manual devices accessible from the banks of a stream should be used whenever possible. If logistic or naturally occurring conditions inhibit this method of sample collection, the samples may be obtained manually by wading up-current (and down-stream) of the sample station. The sample should be collected in an area representative of minimal turbulence and aeration (Babb and Glaser, 1985). Because sample containers may be dipped by hand into the stream, extreme caution must be employed in avoiding contamination into the mouth of the container. The following procedures extracted from the "approved RCRA Ground-Water Sampling and Analysis Plan" (Babb and Glaser, 1985) are recommended for extraction and subsequent collection of surface water samples.

1. Hold the bottle near the base with one hand, and with the other, remove the cap.

2. Rinse the sample container with the water to be sampled prior to filling the container. One exception to this is the coliform sample bottle. This bottle may have a pre-measured amount of sodium thyosulphate to neutralize any chlorine present in the water, therefore, this container should not be rinsed prior to sampling.

3. Push the sample container rapidly into the water (mouth down) and tilt-up towards the current to fill. A depth of about six inches is satisfactory. Great care should be taken to avoid breaching the surface while filling the container.

4. During times of little current movement move the container slowly through the water laterally.

5. During times of extreme drought when stream depths are to shallow to allow submersion of the sample container, a pool may be scooped-out of the channel bottom and allowed to clear prior to sampling.

6. Lift the container from the water, and leave one-half inch of air space, and place the uncontaminated cap back-on the container.

7. Place the samples in styrofoam shipping cartons (on ice) for courier transport to the laboratory.

8. A completed Division of Health Services Form 2887 or equivalent (Figure 3) must be submitted along with the samples to the appropriate certified laboratory performing the analysis.

For additional details and further information on how to properly collect, store and transport stream samples, see N.R.C.D. draft on physical and chemical monitoring (in preparation).

D. Fractured Rock Monitoring

Many portions of Western and Central North Carolina are dominated by fractured cystalline rock. These fractures may be expressed on the surface, but more typically, are characteristic of subsurface environments. Areas

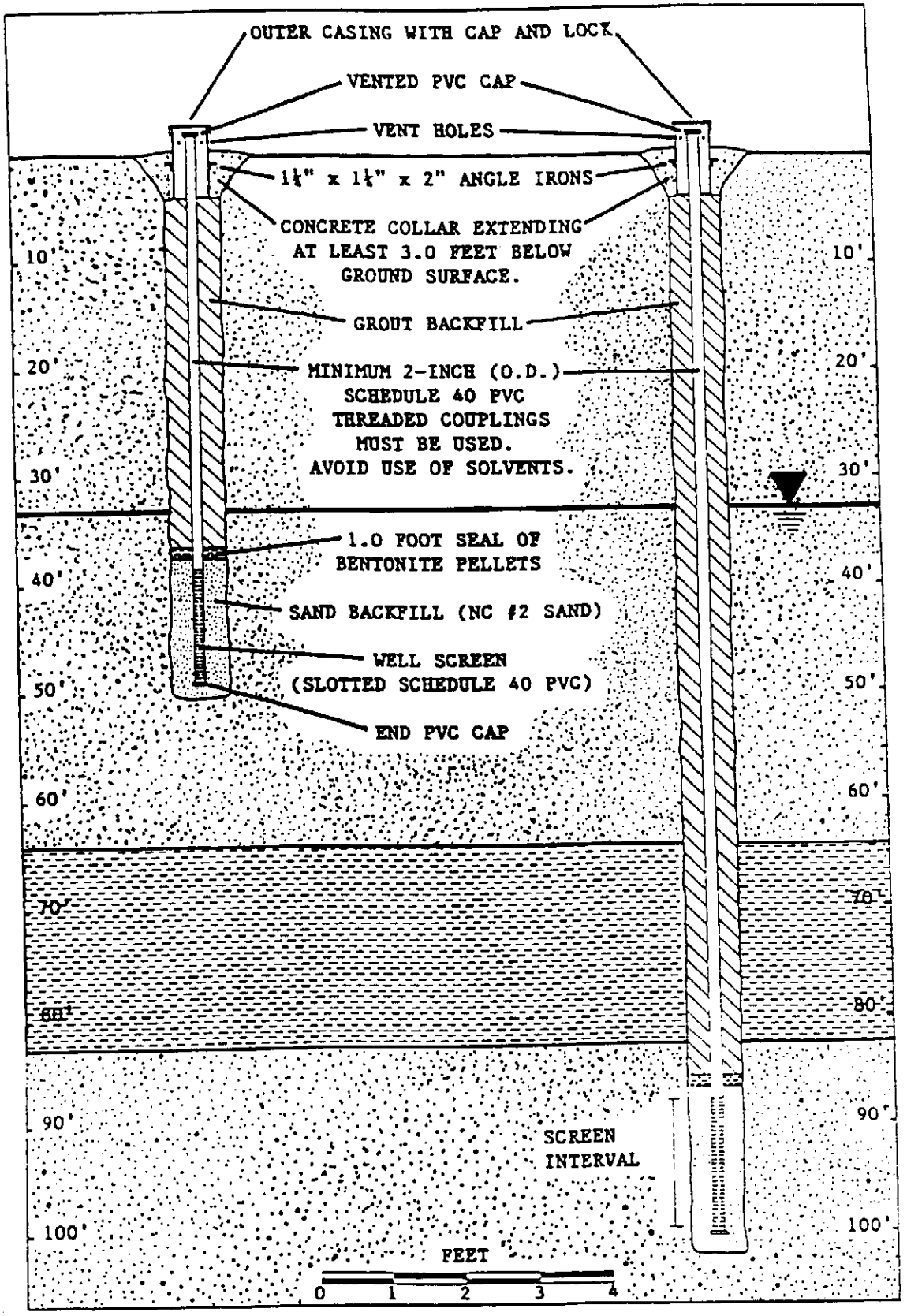


Figure 5. Typical ground-water monitoring well nest schematic.

such as these present inherent technical problems with landfill design and subsequently challenge the effectiveness and integrity of a ground-water monitoring system. The main reason being that fractured rock aquifers offer less predictability and certainty in estimating ground water flow patterns (EPA, 1977).

In order to overcome these difficulties the extent and inclination at depth of these fractures must be ascertained. The most common methods which are available to determine these factors include remote sensing and geophysical surveys. Consultants and engineering firms, may however, specifically utilize and employ these techniques as they see fit in order to adequately address the question of inclination and depth of fracture patterns.

Upon completion of a fracture trace analysis the consulting engineering firm which is responsible for submitting the site plan application will include as part of the proposed ground-water monitoring plan, tentative deep ground-water monitoring well locations at points where fractures intersect and/or at localities characteristic of pronounced lineations which may border or disect the prospective site. As with all proposed well sites, the borehole depths, screen depths and screened intervals will be defined in the report and confirmed with the Division of Health Services prior to drilling. If two aquifers exist beneath a site, a well nest (Figure 5) may be required to adequately assess the migration of potentially contaminanted ground water in both hydrologic regimes..

In most instances, fracture monitoring requires drilling 100 to 200 feet below the surface. This presents a problem for conventional purging methods as described previously in this document. For these wells, a jet pump or equivalent pump which offers a rapid displacement of water will be required for purging. Sampling is performed as described earlier via teflon bailers. A dedicated monitoring system may be used in lui of bailers if depths are not considered a major problem. Consult your industrial representative before purchasing dedicated systems to evaluate the effectiveness of the dedicated device as applied to your specific well requirements.

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APPENDIX B

CHAIN OF CUSTODY AND FIELD SAMPLING DATA SHEET

Sampling Field Data Sheet

GAI CONSULTANTS, INC.

PROJECT: _____ SAMPLERS: _____

FIELD DATA SHEET

MONITORING PT. NUMBER	SAMPLE NUMBER	DATE OF COLLECT.	TIME SAMPLED	SAMPLING PARAMETERS					WATER QUALITY PARAMETERS				
				DTH-G.W.	REF. PT.	VOL. PUR.	SAMP. TY.	SAMP.DTH	pH	TEMP.	SP. COND		

COMMENTS

CHAIN OF CUSTODY RECORD

Date: _____

Customer Name _____

Address _____

_____

Person to Contact _____ Telephone _____

Billing Address _____

_____

Sample Collection Information

Sampling Site _____

Project # _____ Sampler _____

Date of Sample Shipment _____ How Shipped _____

SAMPLE LOG AND ANALYSES REQUEST

Turnaround Requirements

_____ Regular

_____ Rush

_____ FAX Results

Sample ID	Containers # and Type	Date	Time	Matrix	Grab / Comp.	Analysis Requested						Remarks

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Condition on Arrival:

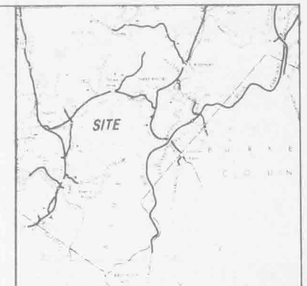
Comments _____

_____

Possible Interfering Compounds _____

Requested by _____

95144.02



VICINITY MAP

LEGEND:

100	EXISTING CONTOURS
125	PROPOSED CONTOURS
	EXISTING DITCH
	PROPOSED DITCH
	EXISTING DRIVE
	PROPOSED DRIVE
	WORK AREA LIMITS
1	WORK AREA DESIGNATION
	TEMPORARY SILT FENCE
S	LIMITS OF PERMANENT SEEDING
O.P.D.	OUTLET PROTECTION DEVICE
D.I.	DROP INLET
	TERRACE

GENERAL NOTES:

1. Silt Basins and Diversion Ditches shall be continuously maintained throughout the operation of the landfill.
2. Silt fence and jute matting shall be used to prevent any erosion of fill slopes constructed during operation of landfill.
3. Temporary seeding shall be performed on all fill slopes as soon as practical during construction.
4. All slopes 3:1 and steeper shall be seeded and covered with straw and asphalt tack.
5. Erosion control measures shall be permanent unless otherwise noted.
6. Temporary erosion control measures may be removed after permanent vegetation has been established.

Base Drawing Supplied By Municipal Engineering Services. GAI Added Existing Monitoring Well 1R And Removed Existing Monitoring Well 1

WATER QUALITY MONITORING PLAN
PLATE 1

NORTH CAROLINA PROFESSIONAL SEAL 6282 ENGINEER JIMMY D. WOODLE

DATE	BY	REV	DESCRIPTION

MUNICIPAL ENGINEERING SERVICES CO., P.A.
CONSULTING ENGINEERS
BOONE N.C. GARNER N.C.

PROJECT: AVERY COUNTY CLOSURE PLAN
OWNER: THE COUNTY AVERY, N.C.
TITLE: PROPOSED FILL & EROSION CONTROL PLAN

SCALE 1" = 40'	DRWN BY LCH	PROJ NO G91010	DRAWING NO 3 OF 7
DATE JULY 1992	CHKD BY DWS		